Food is a substance that:
· Provides body with energy
· Promotes growth and repair of tissues
· Protects against disease (Functional Foods)
The chemical components of foods, which perform these functions, are called nutrients.
Heat is transferred from the outside to the inside of mediums (Flour, Sugar, Salt, Yeast, Water…)

Water is a determinant of sensory properties, inside fruits and vegetables, water pushes from the inside to the outside giving them a "full" sensory property. When water is lost (fruits/vegetables age), they lose volume, texture, and sensory properties.
What gives food their sensory properties is attributed to the Molecular Shape of the water molecule and its ability to form **Hydrogen Bonds.**
Given the Tetrahedral structure of water, water crystallizes into an open structure, which increases by 65% in volume (with spaces inside).
When ice melts, 15% of hydrogen bonds break down and there is a 10% decrease in volume.

Fresh food contains water inside cells, when food is frozen, ice crystals form inside the cells (which causes an increase in their size), when frozen food melts, these cells' layers rupture and allow an outflow of the water resulting in "Thawed food".

What determines the **stability of foods** are the **Chemical/Biochemical Reactions**, and the **Microbial Growth** within them. "Water Activity" represents the "availability" of water for these events to occur.

$$a_w = P/P_0$$

a_w = Water activity
P = Vapor pressure of water in food
P_0 = Vapor pressure of pure water (at the same temperature)

Sorption Isotherms: Curves relating activity of food to its water content at a constant temperature

For each humidity value, a sorption isotherm indicates the corresponding water content value at a given, constant temperature. If the composition or quality of the material changes, then its sorption behavior also changes. Because of the complexity of sorption processes, the isotherms cannot be determined by calculation, but must be recorded experimentally for each product.

Sorption isotherm curves for foods have three slopes,

I: a_w [0-0.2]: describes the moisture content with **TIGHTLY BOUND WATER**

Tightly bound water (**Type I**) is the water layer directly attached to the biopolymer (Ionic and dipole interactions)

II: a_w [0.2-0.75]: describes moisture content with **LOOSELY BOUND WATER**

Type II, is slightly more mobile, water phase, with some solvent capacity (dipole interactions)

III: a_w [0.75-1.0]: describes the moisture content with **FREE WATER**

Available water **(Type III)**, is freezable water, first to break-off, supports any chemical/microbiological activity

Sorption Isotherms: there are two different a_W / Moisture Content curves for Adsorption and Desorption, the two processes exhibit Hysteresis due to bond formations between the side chains of the biopolymer once water activity is zero and the tightly bound water is dehydrated. Once rehydrated, the formed bonds are not replaceable by the water molecules therefore less water molecules bind to the biopolymer meaning that less type I water is present and less water chains form as a result.

Reducing water activity:
Methods: Dehydration, Freezing, Addition of Sugars, and Addition of Salt

Biological Effects: Growth limits of micro-organisms as a result of Water Activity a_W:
[0.68-0.7]:Osmophile Yeast is still present
[7.0-7.5]: Halophile Bacteria still present
[0.78-0.8]: Most Fungi are still present
0.87: Most Yeasts are still present
[0.9-0.95]: Most bacteria are still present